

Implementing Domain Engineering

Presented By
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Course Outline

- Introduction
- Description of the Domain Engineering process
 - Domain Analysis
 - Domain Design
 - Domain Implementation
- Summary

Course Goals

- Become knowledgeable of the process
 - Understand the importance of Domain
 Engineering and the products generated
 - Understand the steps for conducting:
 - » Domain Analysis
 - » Domain Design
 - » Domain Implementation

Group Profile

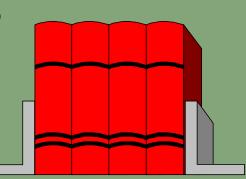
- Who are you?
- What organization do you work for?
- What project are you working on?
- Do you have any experience with domain engineering?
- What are your expectations of this class?

Domain Analysis

Identify the Domain

Identify Information Sources

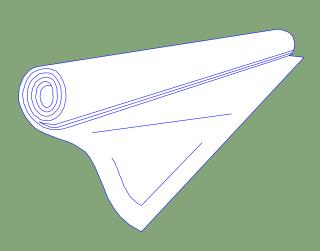
- Identify reliable domain information and expertise
 - Existing and planned systems
 - » Management personnel
 - » Technical personnel
 - » User/Operator documentation
 - » Training material
 - Functional (domain) experts

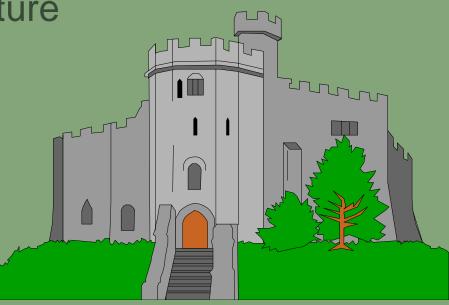


Identify Information Sources

- Domain Knowledge
 - Domain Models

Domain Architecture





Sources of Information

Domain	Documentation				
Expertise	MIL-STD-7935A	DOD-STD-2167A	MIL-STD-498		
Functional Proponents Users	Functional Description System/Sub-System Specification	System/Segment Design Document Software Requirements	Operational Concept Description System/Subsystem Specification Software Development Plan		
System Developers Seminars & Training	Software Unit Specification Database Specification	Specification Interface Requirements Specification	Software Requirements Specs Interface Requirements Specs Interface Design Description Software Input/Output Manual		
Trainers	Users Manual	Interface Design Document Software Design Document	Software Users Manual Software Center Operator Manual		

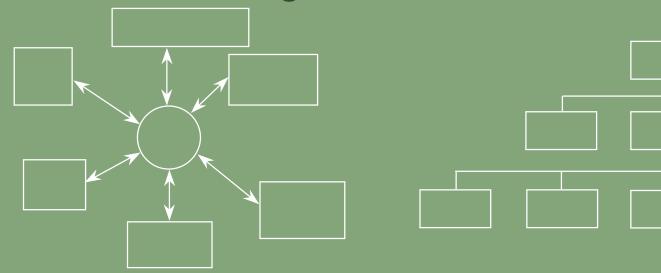
Gather Domain Information

- Using the information sources earlier identified:
 - Conduct interviews with experts
 - Review the documentation
 - Attend training sessions
 - Use existing systems
 - Do independent research

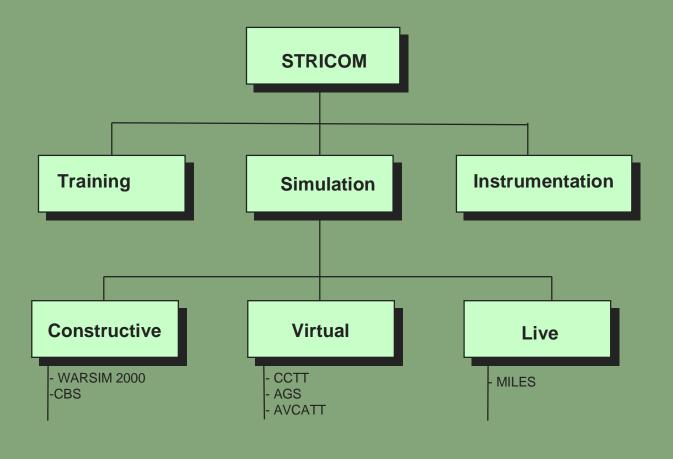


Describe the Domain

- Establish relationships with other domains
- Determine high-level functions



Describe the Domain



Verify Domain Description

- Domain experts independently review the products for accuracy
- Any discrepancies are resolved
- Domain manager approves domain description

Scope the Domain

Establish Scoping Criteria

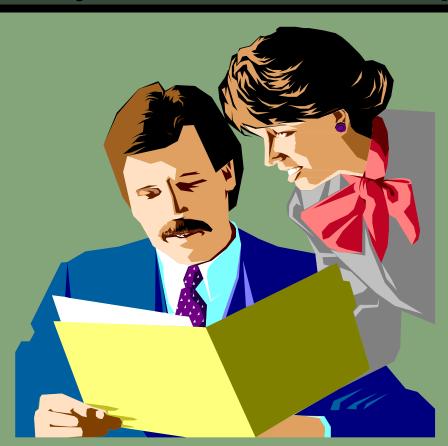
CRITERION	VALUE	WEIGHT
Number of Existing Systems	1-2 3-5 6-n	1 2 3
Future Systems Development	None One or more	0 1
Vertical Reuse	None 1 family 2 or more families	0 1 3
Horizontal Reuse	None or 1 family 2 families 3 or more families	0 1 3
Reuse Expertise	Low Medium High	1 2 3
Stability	Low Medium High	1 2 3
Participation	Low Medium High	1 2 3
Available Information	Low Medium High	1 2 3

Define Domain Boundaries

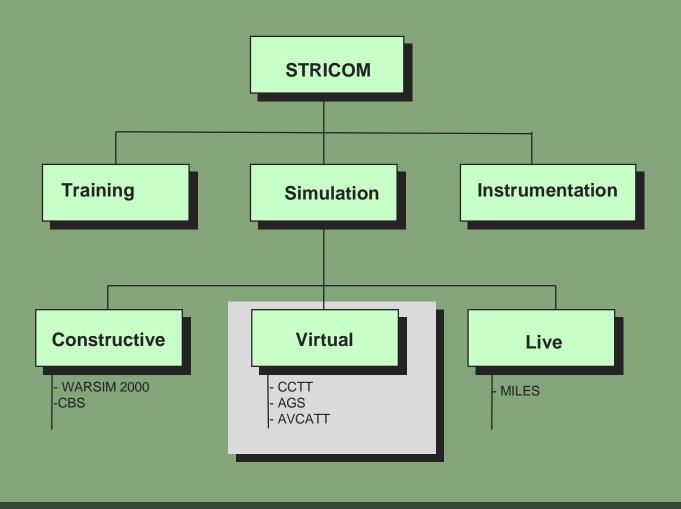
Selection Criteria Candidate Subdomains	# of Existing Systems	Future Systems Development	Vertical Reuse	Horizontal Reuse	Reuse Expertise	Stability	Participation	Available Information	Score
Training	0	1	0	0	1	2	2	2	8
Instrumentation	0	1	1	0	3	3	2	3	13
Virtual	3	1	3	3	2	3	3	3	21
Constructive	2	1	3	1	3	3	2	3	18
Live	1	1	1	0	1	3	3	2	12

Note: This is just an example

Verify Domain Scope



Model the Domain of Focus

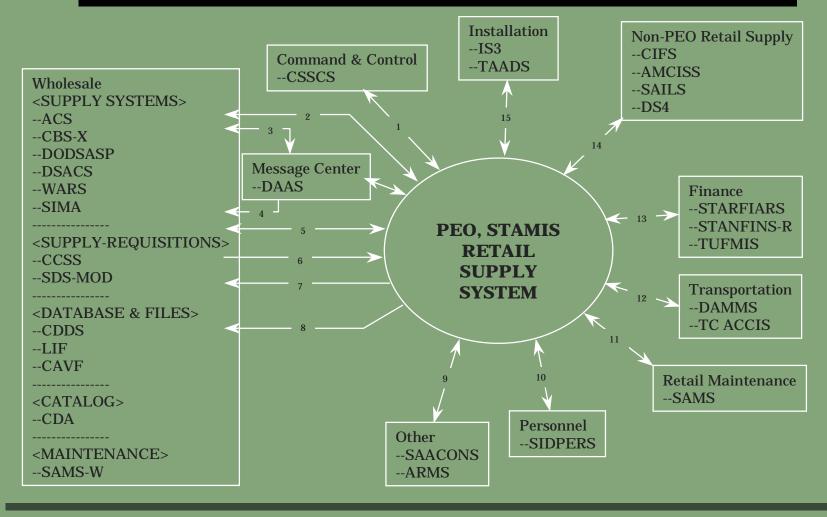


Analyze the Domain

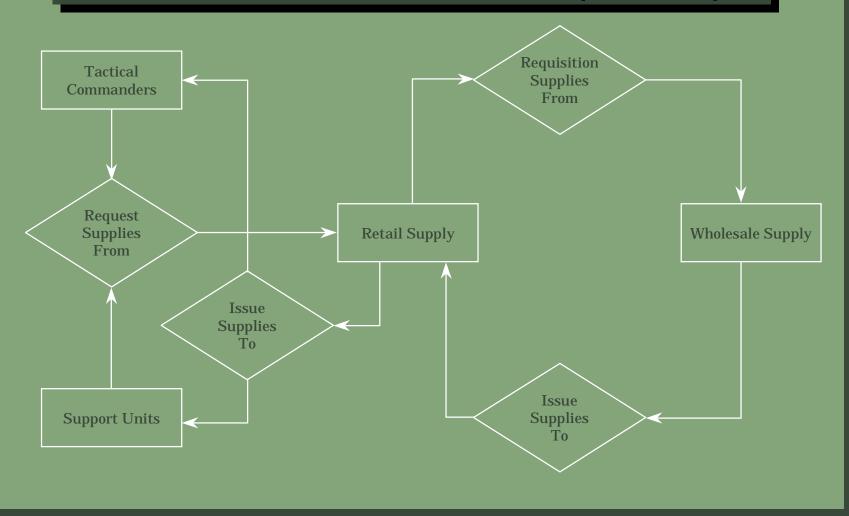
Organize & Synthesize Problem Space Information

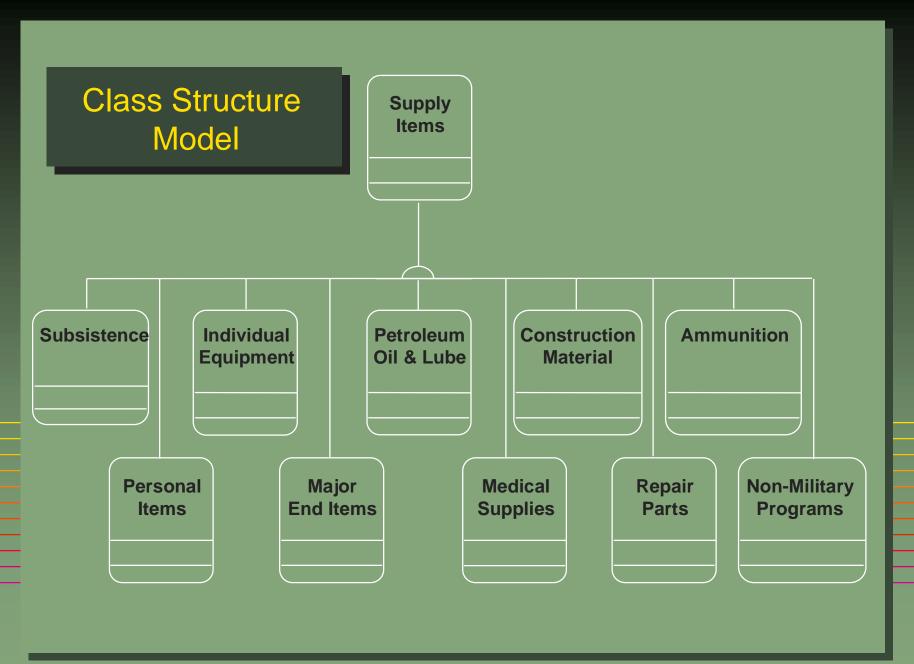
- Begin to gather the information <u>specific</u> to the domain of focus
 - Reverse engineer domain systems
 - Gather information from other Government and DoD agencies
- The analysis thus far is a reusable asset
 - provide to ARC

Context Model



Behavioral Model (ERD)





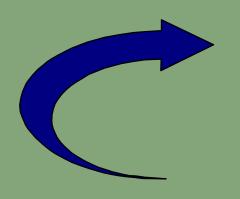
Assembly Structure Model Supply_Item_Record (Ammunition) DoD_Ammunition_Code National_Stock_Number Lot_Number (DODAC) (NSN) **DoD_Identification_Code** Federal_Supply_Class (DODIC) (FSC)

Identify Commonalties

- Identify objects & their relationships
 - Determine composition
 - Identify structure
 - Determine connection
- Determine behavior
- Identify constraints
- Develop and verify common objects model

Identify Objects

An object



Soldier

Name

Rank

DOR

SSN MOS

Change Name Promote/Demote Update DOR Enter SSN

Update/Change MOS

Object Name

Attributes

Services

Identify Commonalities

Sailor

Name

Rank

DOR

SSN

Rating

Total Sea Duty

Change Name

Promote/Demote

Update DOR

Enter SSN

Update/Change Rate

Record Time at Sea

Soldier

Name

Rank

DOR

SSN MOS

Change Name

Promote/Demote

Update DOR

Enter SSN

Update/Change MOS

Airman

Name

Rank

DOR

SSN

AFSC

Total Flight Hours

Change Name

Promote/Demote

Update DOR

Enter SSN

Update/Change AFSC

Record Flight Hours

Promote Commonalties

Military Service Personnel

Name

Rank

DOR

SSN

Change Name

Promote/Demote

Update DOR

Enter SSN

Sailor

Rating

Total Sea Duty

Update/Change Rating Record Time at Sea

Soldier

MOS

Update/Change MOS

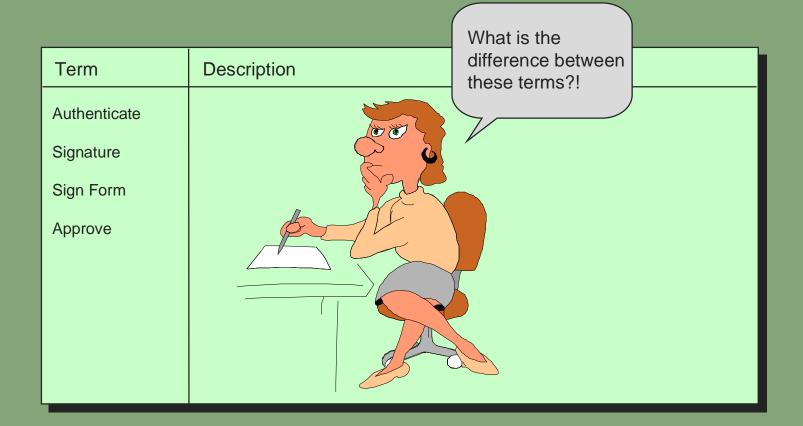
Airman

AFSC

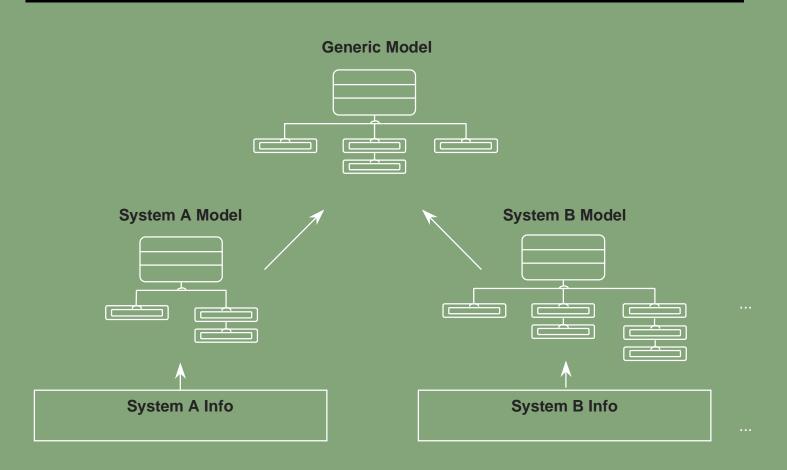
Tota Flight Hours

Update/Change AFSC Record Flight Hours

Domain Lexicon



The Modeling Process

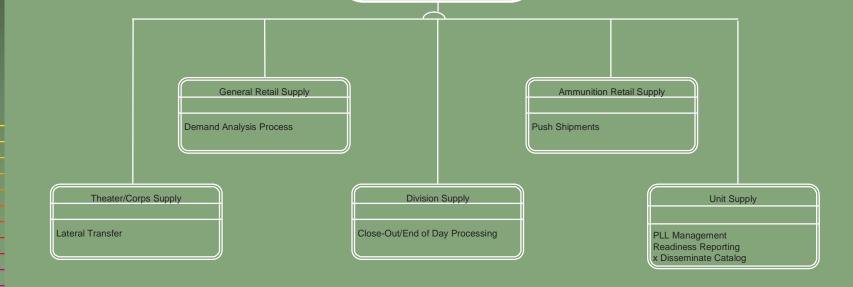


Logical Model -Generic View

Retail Supply

Transaction Inventory Catalog

Accept Incoming Request Cancel/Modify Incoming Request Prepare Outgoing Request Cancel/Modify Outgoing Request Receive Stock Issue Stock Perform Inventory Maintain Stock Levels Query Catalog Update Catalog Disseminate Catalog



Logical Model -System View

Retail Supply

Transaction Inventory Catalog

Accept Incoming Request Cancel/Modify Incoming Request Prepare Outgoing Request Cancel/Modify Outgoing Request Receive Stock Issue Stock Perform Inventory Maintain Stock Levels Query Catalog Update Catalog Disseminate Catalog

General Retail Supply

Demand Analysis Process

SARSS-2A

Retrograde Non-issuable RIC Stockable Levels Minimum or Maximum Requisitioning Objectives DODAAC History Journal (SNR Transfers)

Daily Performance Statistics
Statistical Reports

Referral Process

Reparable Management Process
Manager Directed Issues of Restricted Stock Process
Centralized Repair Line Process

Stockage Level Management Process Manager Control Echelon Process

Manager Control Degree Process

Local Purchase Parameter Process

DODACC Process

Transactions-In Process
Transactions-Out Process

SARSS Network Router (SNR) Performance Standards Process

Lateral Transfer

SARSS-2B

Automatic Return Items List Authorized Stockage List Requisitioning Objectives Demand Data x Requests

Material Obligation Validation Process
Document History Purge Process
Document History ABF Extract Process
Command ASL/Provisor Mater File Process
TIRSA Stockage Computation Process

Transactions-In/Out Process

Financial Reconciliation Process x Request Process

x Receipt/Status Process

Manager Review File Process

x Issue Process

x Maintain Stockage

SARSS-2AC

Catalog Build Process Catalog Standalone Process Stock Rotation Process Retrograde RIC

Theater/Corps Supply

Class/Object Specifications

Class/Object Name: Retail Supply System

Description: The Retail Supply class is focused on systems that provide logistical support in the form of supply replenishment for the ten DoD classes of supply. Most systems that have direct (SAARS,SAAS) or indirect (SAMS) supply responsibilities will have the following data and capability characteristics.

Source(s): PEO-STAMIS Retail Supply domain analysis

Adaptation Requirements (Variants): None

Constraints: None Concurrency: None

Structure:

Whole_To: None Part Of: None

Generalize_To: General Retail, Theater/Corps, Division, Company,

Ammunition Retail

Specialization_To: None

Connection:

Instance: None Message: None

Donor/Client Mapping

Issue Process [Element, Retail Supply]

Description: The Issue element category consists of assets that provide for release of supply items to a customer in response to a valid request for issue. Supplies are normally issued with receipt documents.

Rationale: All retail supply systems require the capability to issue supplies in response to a customer's request or requisition.

Mapping:

DONOR	TYPE	CLIENT
SAAS-DAO, SAAS-4, SAMS-1 (Supply), SARSS-1, SARSS-2A, SPBS-R SPBS-R-I/TDA SAAS-1/3 ULLS-G (Supply), ULLS-A(Supply), SAMS-I/TDA (Supply)	Requirements, Design, Code	SAMS-I/TDA upgrades (Supply), SARSS upgrades, ULLS-S4 (Supply), [Retail Supply Systems]
ULLS-S4 (Supply)	Requirements, Design	SAMS-I/TDA upgrades SARSS upgrades, [Retail Supply Systems]

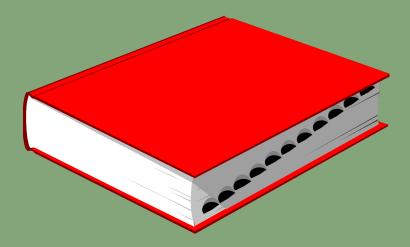
Domain Design

Identify Domain Constraints

- Management directives
- Government Off-The-Shelf (GOTS) & Commercial Off-The-Shelf (COTS)
- Hardware platform
- Common Operating Environment (COE)
 - DBMS
 - GUI
 - Communication interfaces

Collect and Organize Solution Space Information

- Develop a design catalogue
 - Existing design solutions (reusable assets)
 - Domain constraints
 - Lessons learned



Survey Domain-Specific Parts

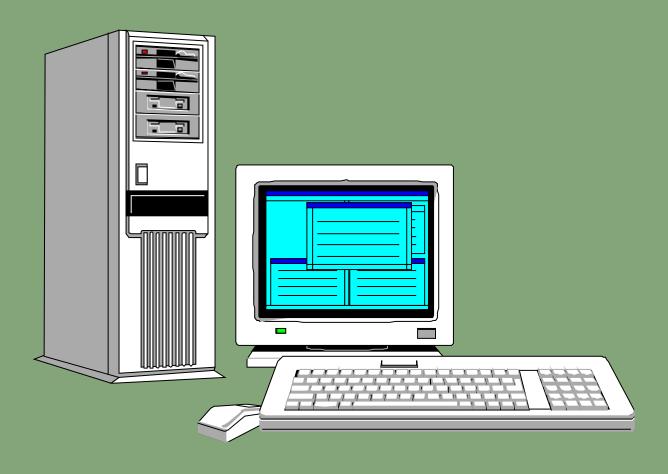
- Compare architectural components with modeled requirements
- Assess degree of reusability
- Capture classification information
- Decompose to next lower level of detail



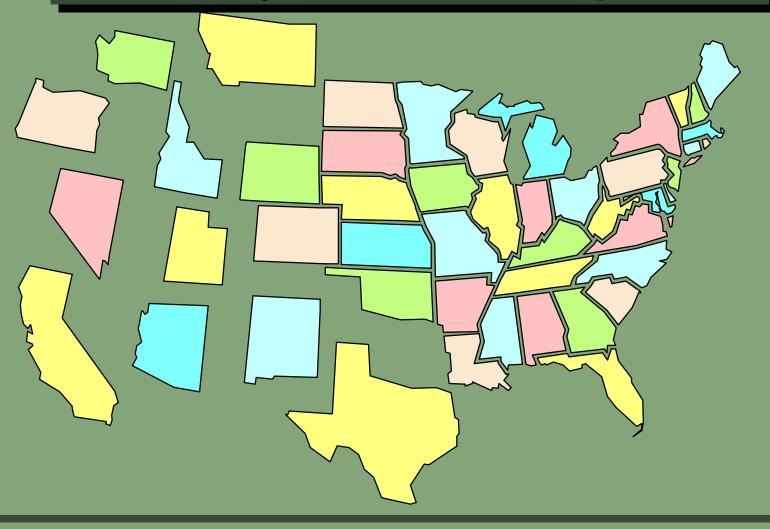
Just how reusable is it?



Record the findings



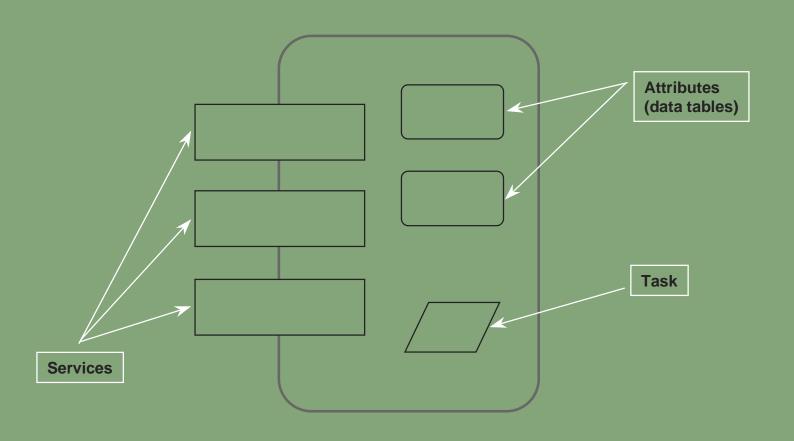
It's only the sum of its parts



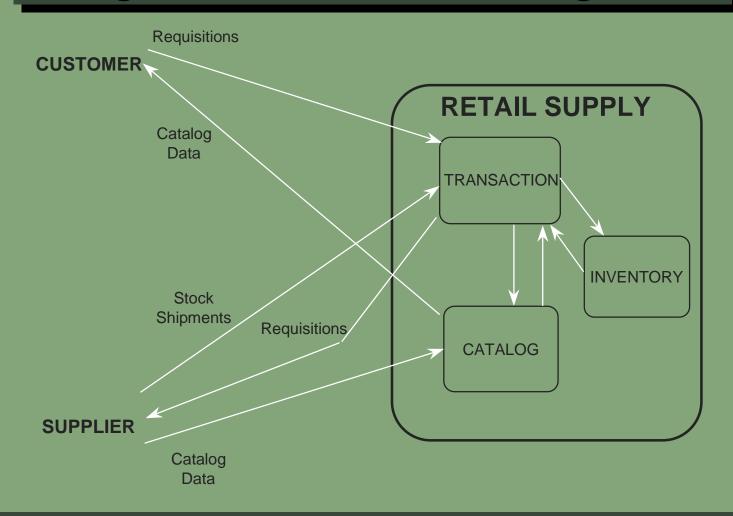
Develop Domain-Specific Software Architecture (DSSA)

- Develop high-level DSSA(s)
- Identify trade-offs and rationale for alternate DSSA(s)
- Select DSSA
- Develop specifications
- Decompose to lower-level
- Develop DSSA classification terms
- Develop DSSA guidelines

Module Diagram Icons

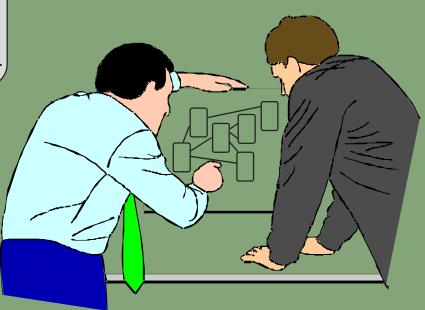


High-Level DSSA Diagram



Which one best meets our customers needs?

The analysis took quite some time. Suggest we go with this one.



True. This design is less expensive. We can implement now and add later.

Class/Object Specifications

Class/Object Name: Retail Supply System

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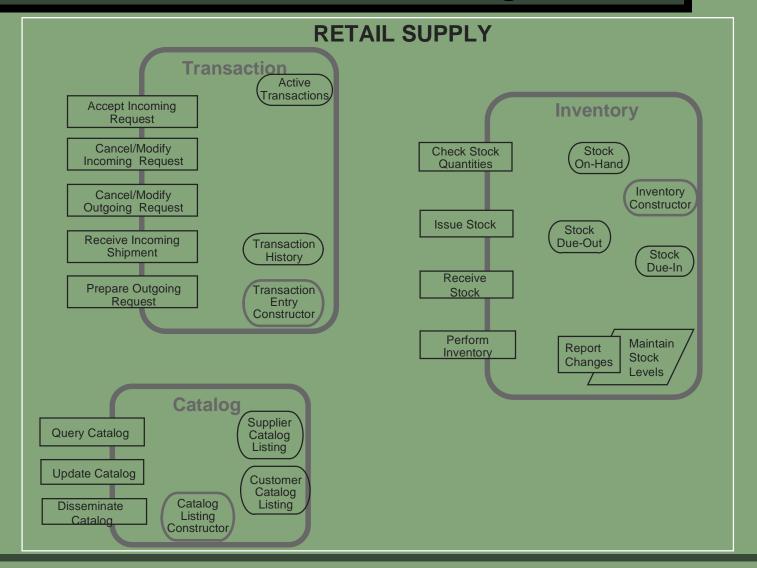
Ammunition Retail

Specialization_To: None

Connection:

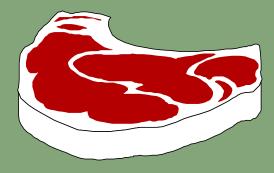
Instance: None Message: None

Low-Level DSSA Diagram

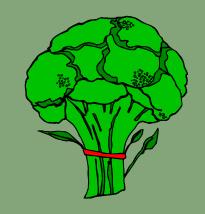


What's the best way to describe this component?



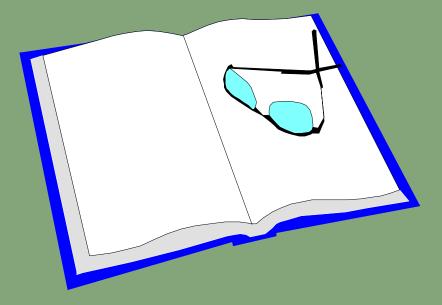








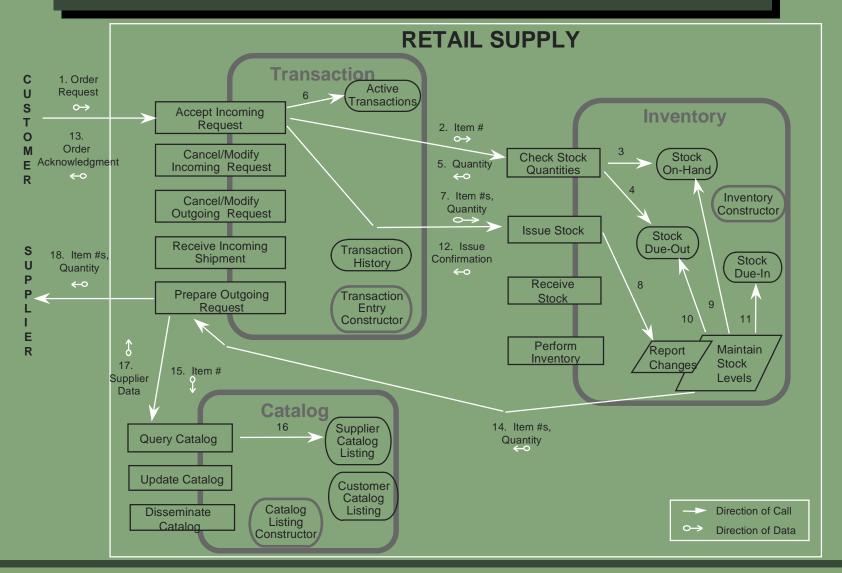
Complete and Unabridged



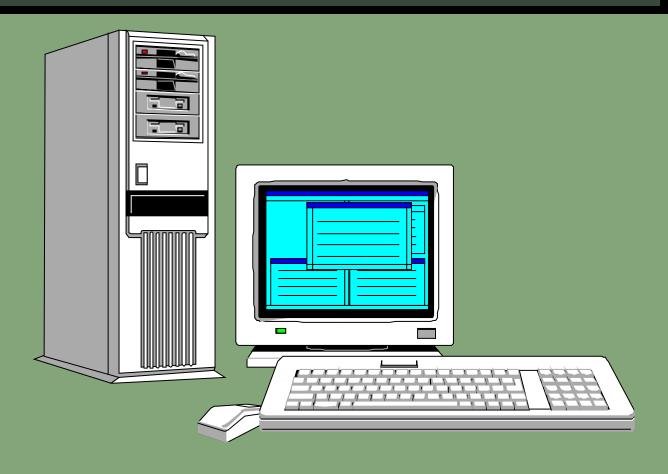
Validate DSSA

- Inspection
- Simulation
- Prototype

Validation Scenario



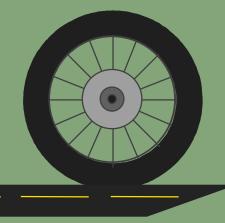
Domain Knowledge Database



Domain Implementation

The Three B's

- Borrow
 - Obtain from a reuse repository
- Buy
 - Purchasing COTS products
- Build
 - Developing a new, reusable asset



Summary

- Requires expertise in
 - Domain engineering
 - The domain/functional area
- Critical to separate problem space from solution space (what vs. how)
- Developing a domain knowledge-base at the start eliminates problems and facilitates sharing of information

- Domain Engineering is a state-of-the-art technology
- Domain Engineering products continue to evolve
- Tools are required for the Domain Engineering process

- Information sources should be kept for future Domain Engineering activities
- Availability and cooperation of domain experts is critical to the success of the project
 - Involve domain experts early to minimize errors and expedite validation process
 - Use same domain experts throughout the Domain Engineering process

- Documentation is frequently outdated
- Management's commitment and support is required
- The object-oriented paradigm facilitates identification of commonalties and their variations
- Develop a domain knowledge base/catalogue of the relevant information

Use abstraction and partitioning to manage the complexity of the domain